EM433 - COMPUTER-AIDED MANUFACTURING

SUBMISSION REQUIREMENTS FOR MACHINING JOBS IN TSD

1. The following information is to be provided in duplicate to TSD when submitting any jobs for CNC machining:
    a) Work Request, identifying exactly what is to be done. You can refer to supporting documents such as drawings, etc. to help describe the work to be performed. State on the work request the times that you are available to witness the manufacture of your parts. It is highly encouraged that you be present when your job is being machined. Make sure you leave a phone number and e-mail address so that the machinist can contact you if he has any questions about the job when he is planning it out. Blank forms are available from Mr. Tom Price in the shop
    b) Accurate, fully dimensioned CAD drawings of the part to be manufactured and any auxiliary fixtures such as machinable base plates. *You must include manufacturing information for each fixture that must be prepared, the same as you do for your actual parts.*
    c) Size of starting stock and material to be used.
    d) Accurate drawings of each machine tool setup to be used in manufacturing your part, clearly identify where clamps are to be positioned and how stock is to be secured to the machine tool.
    e) Clearly identify the local origin of your machine coordinate system. In general, the MCS should be positioned on, or at least referenced to, the top surface of the stock for mill work and on the face farthest from the chuck on the lathe.
    f) A **process plan** indicating:
        - the order of setups,
        - the machining operations to be performed in each setup,
        - the cutting tools and the tool station numbers assigned to the tools
        - name of the NC file.

    For each machining operation, state
        - the cutter size and
        - type of cut (roughing, finishing, volume clear, profile, turning, facing, threading, etc.),
        - the max. depth of cut per pass,
        - feed rate and (not req'd for mill jobs)
        - spindle speed (not req'd for mill jobs)

    g) 3.5 in. diskette containing the necessary NC files. A listing of the NC tape file containing the G-codes (not the CLDATA). Clearly identify where the tool changes occur in the program
    h) A sample Job Submittal package is attached.
2. All Job Submittals are to be reviewed for accuracy and completeness by Prof. Link before they are turned into Mr. Tom Price down in the shop. This will include reviewing your animated toolpaths in I-DEAS.

— SAMPLE —

PREPARE ORIGINAL + 1

(For TSD use only)

SHOP WORK REQUEST
Technical Support Department
TO: Director, Technical Support Department

TSD JOB NUMBER:

NAME OF REQUESTOR (PRINT OR TYPE)	DEPARTMENT	PHONE EXT.	DATE OF REQUEST
PROF. LINK	ME	x36523	01 FEB 97

TITLE OF JOB	COURSE NUMBER	DESIRED COMPLETION DATE
CNC MACHINE SLOT BLOCK	EM486A	07 FEB 97

CATEGORY OF WORK

- [ ] FACULTY R&D
- [ ] LABORATORY SUPPORT
- [ ] VIP
- [X] MIDSHIPMEN PROJECTS
- [ ] MAINTENANCE
- [ ] OTHER
- [ ] TRIDENT PROJECTS
- [ ] GENERAL SUPPORT
- [ ] NON-DIVISION

JOB ORDER NUMBERS
LABOR:
MATERIALS:

URGENCY

SEMESTER MANUFACTURING PROJECT. REQUIRED FOR COMPLETION OF COURSE.

JOB DESCRIPTION

1. SERVICES OF TSD TO CNC A "SLOT BLOCK", DWG. #1
   I WOULD LIKE TO WITNESS THE SETUP & MACHINING OF THE PART.
2. DRAWINGS FOR STARTING STOCK AND REQ'D FIXTURES ARE ATTACHED. PROCESS PLAN IS ALSO ATTACHED.
3. TAPE FILE FOR HEIDENHAIN MILL IS ON FLOPPY DISK, FILE NAME IS: SLOTBLOK.HEI
   LISTING ATTACHED

ENCL: 5 DRAWINGS
1 PROCESS PLAN
1 TAPE FILE LISTING
1 FLOPPY DISK

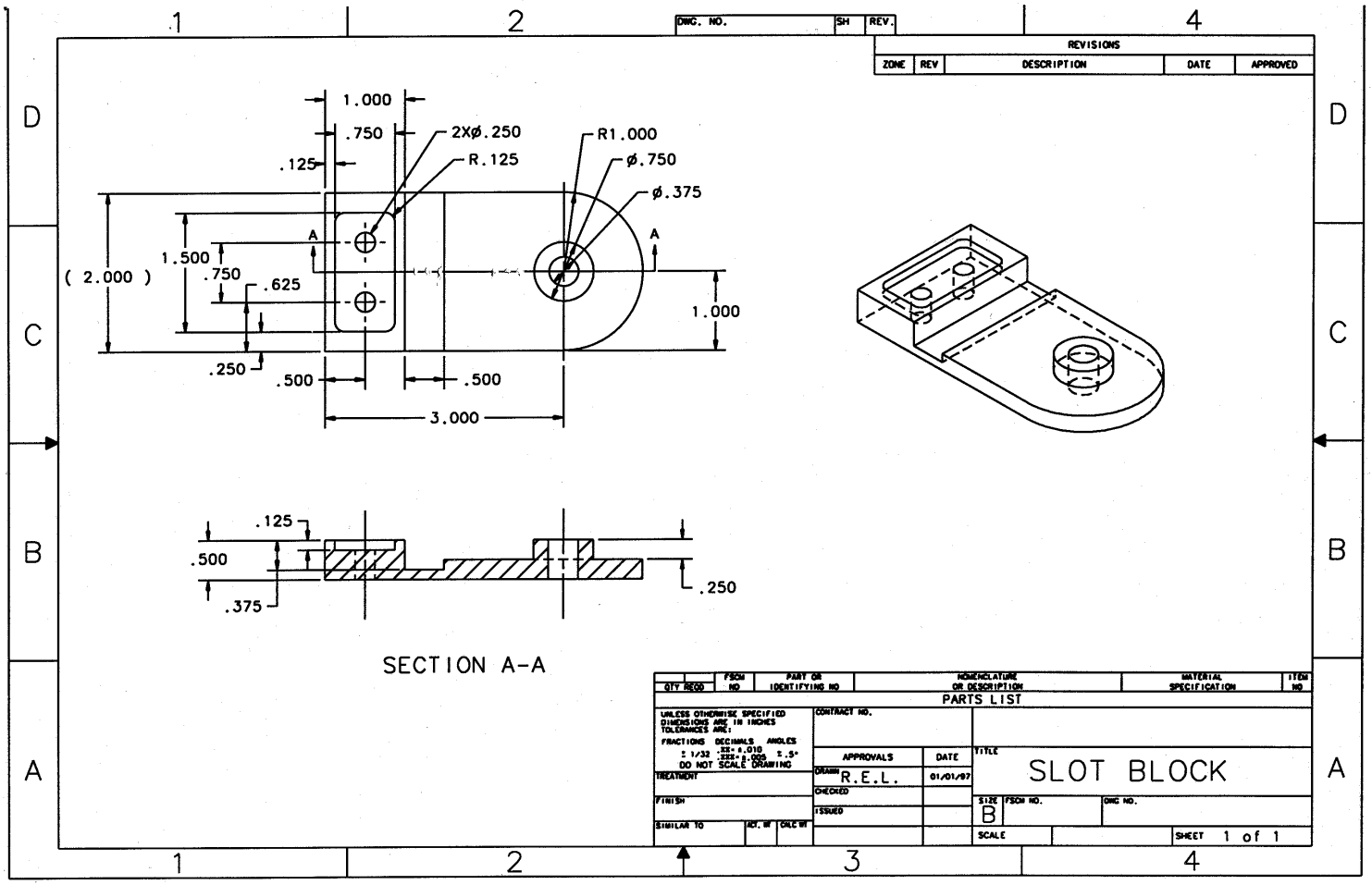
COMMENTS: AVAILABLE TIMES: TU: 0730-0945, MW: 1430-1630, FRI: 0730-1145

e-mail: link@usna.navy.mil

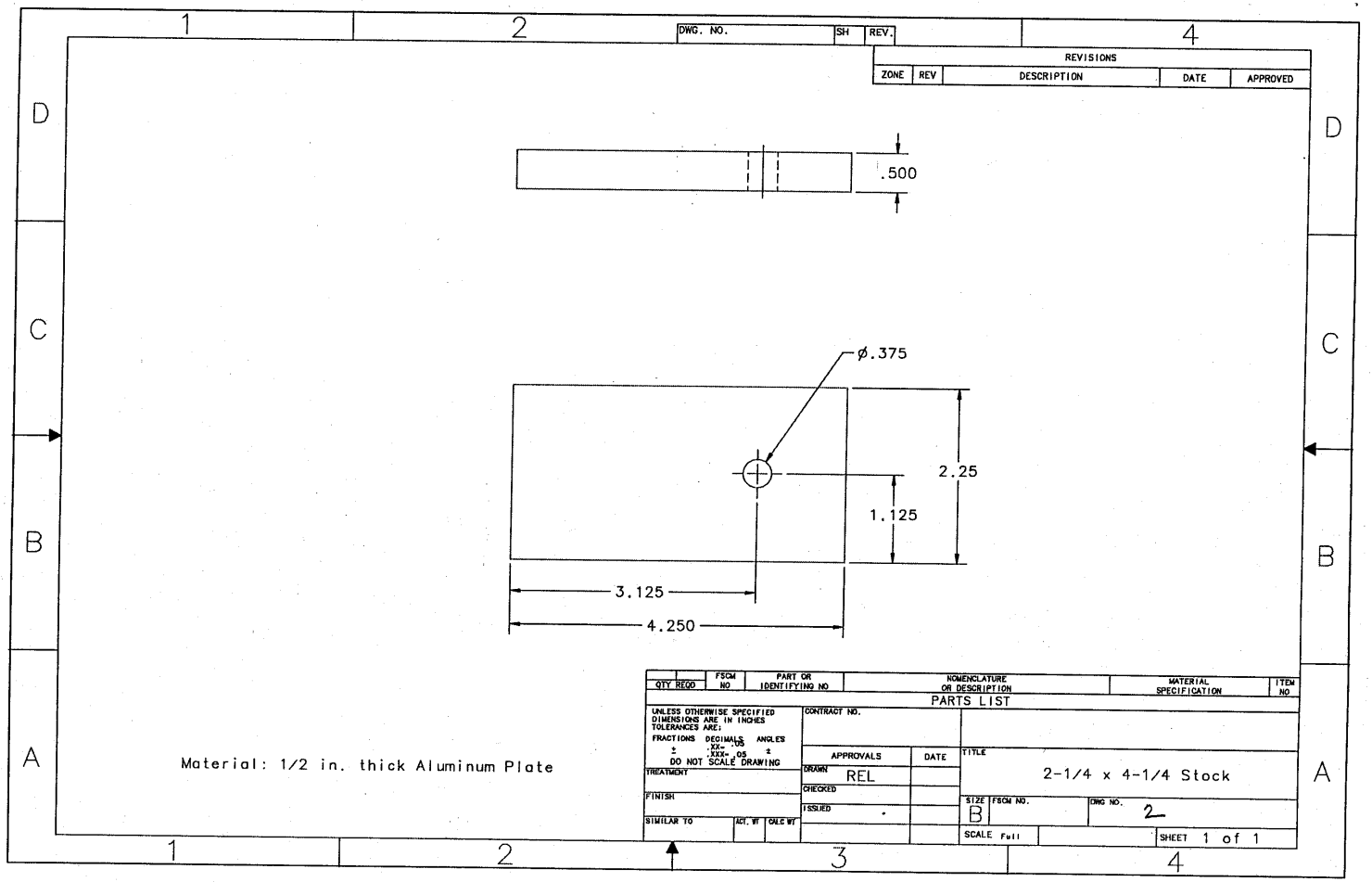
SIGNATURE OF REQUESTOR	INITALS OF DEP. CHRMN.	INITIALS TSD ESTIMATOR	DATE

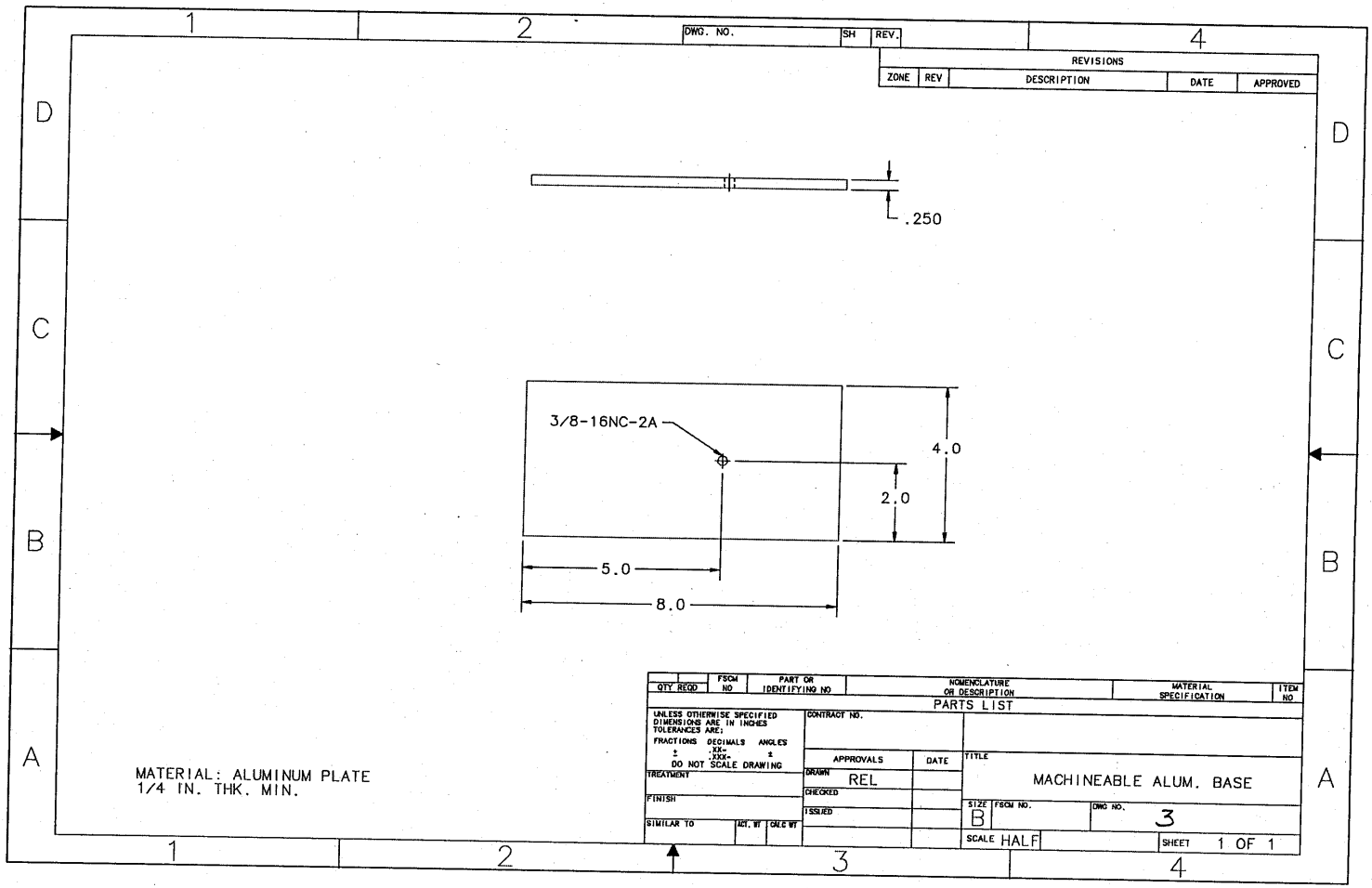
INIT. DIR. TSD	ACTION
	[ ] IMMEDIATE [ ] ROUTINE [ ] DEFER [ ] DISAPPROVE [ ] PW DEPT. [ ]

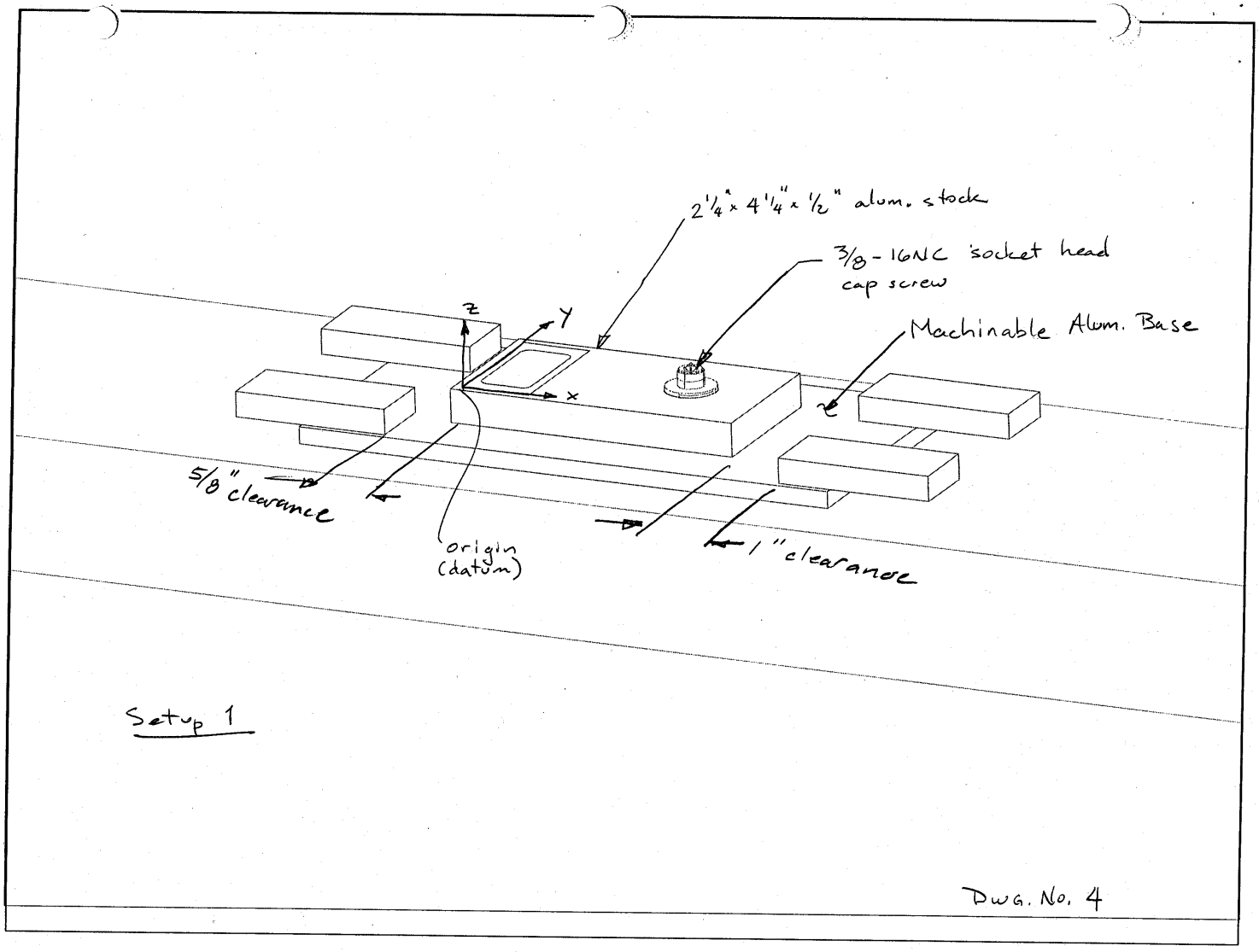
USNA-CDA-9665/02 (Rev.06-93)


1.000
.750
.125
2XØ.250
R.125
R1.000
Ø.750
Ø.375
A
A
1.500
.750
.625
(2.000)
1.000
.250
.500
.500
3.000
.125
.500
.375
.250
SECTION A-A
DWG. NO.
SH
REV.
REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
QTY REQD
FSCM NO
PART OR IDENTIFYING NO
NOMENCLATURE OR DESCRIPTION
MATERIAL SPECIFICATION
ITEM NO
PARTS LIST
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± 1/32 .XX± 0.010 ±.5°
DO NOT SCALE DRAWING
CONTRACT NO.
APPROVALS
DATE
DRAWN R.E.L.
01/01/97
CHECKED
ISSUED
TREATMENT
FINISH
SIMILAR TO
MAT. BY
CALC BY
TITLE
SLOT BLOCK
SIZE B
FSCM NO.
DWG NO.
SCALE
SHEET 1 of 1
1
2
3
4
A
B
C
D

Drawing #1

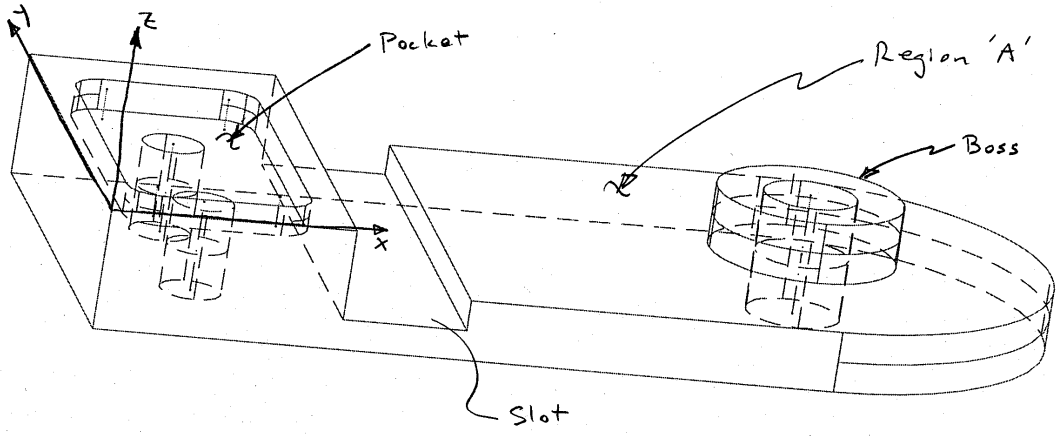

DWG. NO.
SH
REV.
REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
.500
Ø.375
2.25
1.125
3.125
4.250
Material: 1/2 in. thick Aluminum Plate
QTY REQD
FSCM NO
PART OR IDENTIFYING NO
NOMENCLATURE OR DESCRIPTION
MATERIAL SPECIFICATION
ITEM NO
PARTS LIST
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS
DECIMALS .XX= .05 .XXX= .05
ANGLES ±
DO NOT SCALE DRAWING
TREATMENT
FINISH
SIMILAR TO
ACT. WT
CALC WT
CONTRACT NO.
APPROVALS
DATE
DRAWN
REL
CHECKED
ISSUED
TITLE
2-1/4 x 4-1/4 Stock
SIZE
B
FSCM NO.
DWG NO.
2
SCALE Full
SHEET 1 of 1


1
2
3
4
A
B
C
D
DWG. NO.
SH
REV.
REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
.250
3/8-16NC-2A
4.0
2.0
5.0
8.0
MATERIAL: ALUMINUM PLATE
1/4 IN. THK. MIN.
QTY REQD
FSCM NO
PART OR IDENTIFYING NO
NOMENCLATURE OR DESCRIPTION
MATERIAL SPECIFICATION
ITEM NO
PARTS LIST
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± .XX± ±
.XXX±
DO NOT SCALE DRAWING
TREATMENT
FINISH
SIMILAR TO
NEXT ASSY
USED ON
APPLICATION
CONTRACT NO.
APPROVALS
DATE
DRAWN
REL
CHECKED
ISSUED
TITLE
MACHINEABLE ALUM. BASE
SIZE
B
FSCM NO.
DWG NO.
3
SCALE HALF
SHEET 1 OF 1



Setup 1

Dwg. No. 4



Dwg. No. 5

PROCESS PLAN SHEET

Job Name: SLOT BLOCK

Submitted by: R. LINK
e-mail: link@usna.navy.mil

Material: ALUMINUM PLATE
Starting Stock: 2 1/4 x 4 1/4 x 1/2 , Drawing # 2

Tooling Summary (list of all cutting tools, clamps, fixtures, etc.)
Machinable base as shown on dwg # 3, 3/8-16NC socket head cap screw
Step block clamps
1/2 in. end mill
1/4 in. end mill
1/4 in. twist drill

Setup # 1 of 1
NC File Name: SLOTBLOK.HEI
Machine Tool: Heidenhain Mill

Setup Description:
See drawing # 4. Stock bolted to machinable base, machinable base is clamped to mill table with step block clamps. Origin is located on top of stock as shown. Drawing # 5 shows features described below

Oper. #	Description (feature to be machined, type of cut, rough, finish, turn, thread...)	Tool	Tool #
1	Rough out pocket and region 'A' to a depth of 0.115.	1/2" end	1
	Max. depth/pass = 0.115. Speed = 2200 rpm Feed: 18-22 IPM	mill	
2	Finish around boss, rough the profile		1
	Max depth/pass = 0.125 Speed = 2200 rpm Feed = 18-22 IPM		
3	Finish cut profile. Max. depth of cut = 0.040 (into machinable base)		1
	Speed = 2200 rpm Feed: 18-22 IPM		

continued

PROCESS PLAN SHEET

Job Name: SLOT BLOCK

Oper. #	Description (feature to be machined, type of cut, rough,finish, turn, thread...)	Tool	Tool #
4	Finish the pocket and slot. Max. depth of cut = 0.125	1/4" end mill	2
	Speed: 2200 rpm Feed: 18 IPM		
5	Peck drill the 1/4" holes in the pocket	1/4" drill	3
	Depth of cut: Thru part + 0.1 (0.6)		
	Speed: 1800 rpm Feed: 0.005 ipr		

LISTING OF SLOTBLOK.HET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N50 G99 L0.0000 R0.0000 T2
N55 G99 L0.0000 R0.0000 T3
N60 G99 L0.0000 R0.0000 T4
N65 G99 L0.0000 R0.0000 T5
N70 G99 L0.0000 R0.0000 T6
N75 G99 L0.0000 R0.0000 T7
N80 G99 L0.0000 R0.0000 T8
N85 G99 L0.0000 R0.0000 T9
N90 G00 X-5.0000 Y0.0000 Z1.0000
N95 G00
N100 M6
N105 T1 ——— Tool #1  1/2" end mill
N110 S2240 M3                Operation #1
N115 Z1.0108 F180
N120 X1.9787 Y1.0000
N125 Z0.5138
N130 G01 X1.9787 Z-0.1150
N135 X1.9787 Y0.5938
N140 X2.1225
N145 X2.2594
N150 G17
N155 I2.2594 J0.5062 G02 X2.3469 Y0.5062
N160 I2.2594 J0.5062 X2.2594 Y0.4187
N165 I2.2594 J0.5062 X2.1800 Y0.4695
N170 G01 X2.1225 Y0.5938
N175 I3.0000 J1.0000 G02 X2.0330 Y1.0000
N180 G01 X2.0330
N185 I3.0000 J1.0000 G02 X2.1225 Y1.4063
N190 G01 X2.1800 Y1.5305
N195 I2.2594 J1.4938 G02 X2.2594 Y1.5813
N200 I2.2594 J1.4938 X2.3469 Y1.4938
N205 I2.2594 J1.4938 X2.2594 Y1.4062
N210 G01 X2.1225 Y1.4063
N215 X1.9787
N220 X1.9787 Y1.0000
N225 X1.7287
N230 X1.7287 Y0.5137 F220
N235 X1.7287 Y0.3438 F180
N240 X1.8987
N245 X2.2025 F220
N250 X2.7112 F180
N255 I3.0000 J1.0000 G02 X2.3813 Y0.6377
N260 F220
N265 I3.0000 J1.0000 X2.2830 Y1.0000
N270 G01 X2.2830
N275 I3.0000 J1.0000 G02 X2.3813 Y1.3623
N280 F180
N285 I3.0000 J1.0000 X2.7112 Y1.6563
N290 G01 X2.2025
N295 X1.8987 F220
N300 X1.7287 F180
N305 X1.7287 Y1.4863
N310 X1.7287 Y1.0000 F220
N315 X1.7287 Z-0.0150 F180
N320 G00 Z1.0108
N325 X3.5070 Y0.4930
N330 Z0.5138
N335 G01 X3.5070 Z-0.1150
N340 I3.0000 J1.0000 G02 X3.2888 Y0.3438
N345 G01 X3.6562
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N350 X3.6562 Y0.7112
N355 I3.0000 J1.0000 G02 X3.5070 Y0.4930
N360 G01 X3.5070 Z-0.0150
N365 G00 Z1.0108
N370 Y1.5070
N375 Z0.5138
N380 G01 X3.5070 Z-0.1150
N385 I3.0000 J1.0000 G02 X3.6562 Y1.2888
N390 G01 X3.6562 Y1.6563
N395 X3.2888
N400 I3.0000 J1.0000 G02 X3.5070 Y1.5070
N405 G01 X3.9062
N410 X3.9062 Y1.7363 F220
N415 X3.9062 Y1.9063 F180
N420 X3.7363
N425 X3.2088 F220
N430 X2.7912 F180
N435 X1.6487 F220
N440 X1.4787 F180
N445 X1.4787 Y1.7363
N450 X1.4787 Y0.2637 F220
N455 X1.4787 Y0.0938 F180
N460 X1.6487
N465 X2.7912 F220
N470 X3.2088 F180
N475 X3.7363 F220
N480 X3.9062 F180
N485 X3.9062 Y0.2637
N490 X3.9062 Y0.7912 F220
N495 X3.9062 Y1.2088 F180
N500 X3.9062 Y1.5070 F220
N505 X4.1250 F180
N510 X4.1250 Y2.0514 F220
N515 X4.1250 Y2.1250 F180
N520 X4.0514
N525 X1.3336 F220
N530 X1.2280 F180
N535 I1.0000 J2.0000 G02 X1.2560 Y2.0452
N540 G01 X1.2600 Y2.0000 F220
N545 X1.2600 Y0.0000
N550 X1.2560 Y-0.0452
N555 F180
N560 I1.0000 J0.0000 G02 X1.2280 Y-0.1250
N565 G01 X1.3336
N570 X4.0514 F220
N575 X4.1250 F180
N580 X4.1250 Y-0.0514
N585 X4.1250 Y1.5070 F220
N590 X4.1250 Z-0.0150 F180
N595 G00 Z1.0108
N600 X2.2830 Y1.0000
N605 Z0.5138
N610 G01 X2.2830 Z-0.1150
N615 X2.2830 F220
N620 I3.0000 J1.0000 G02 X3.0000 Y1.7170
N625 I3.0000 J1.0000 X3.7170 Y1.0000
N630 G01 X3.7170
N635 I3.0000 J1.0000 G02 X3.0000 Y0.2830
N640 I3.0000 J1.0000 X2.2830 Y1.0000
N645 G01 X2.2830 Z-0.0150 F180
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N1850 I1.0000 J2.0000 G02 X1.2498 Y2.0100
N1855 G01 X1.2498 Z-0.2750 F180
N1860 G00 Z1.0008
N1865 Y-0.0100
N1870 Z-0.1500
N1875 G01 X1.2498 Z-0.3750
N1880 F220
N1885 I1.0000 J0.0000 G02 X1.0000 Y-0.2500
N1890 G01 X1.0000 Z-0.2750 F180
N1895 G00 Z1.0008
N1900 S2240 M3
N1905 X-0.2500 Y0.0000
N1910 Z-0.4300
N1915 G01 X-0.2500 Z-0.5300
N1920 X-0.2500 Y2.0000
N1925 I0.0000 J2.0000 G02 X0.0000 Y2.2500
N1930 G01 X3.0000
N1935 I3.0000 J1.0000 G02 X4.2500 Y1.0000
N1940 I3.0000 J1.0000 X3.0000 Y-0.2500
N1945 G01 X0.0000
N1950 I0.0000 J0.0000 G02 X-0.2500 Y0.0000
N1955 I-0.5000 J0.0000 G03 X-0.3327 Y0.1858
N1960 G01 X-0.4256 Y0.2694
N1965 X-0.5185 Y0.3531
N1970 X-0.5185 Z-0.4300
N1975 G00 Z1.0008
N1980 Z1.0000
N1985 X-5.0000 Y0.0000
N1990 M6
N1995 T2
N2000 S2240 M3
N2005 Z1.0008
N2010 X0.5000 Y1.0000
N2015 Z0.5138
N2020 G01 X0.5000 Z-0.1250
N2025 X0.5000 Y0.6250
N2030 X0.5000 Y1.3750
N2035 X0.5000 Y1.0000
N2040 X0.3750
N2045 X0.3750 Y0.5000
N2050 X0.6250
N2055 X0.6250 Y1.5000
N2060 X0.3750
N2065 X0.3750 Y1.0000
N2070 X0.2500
N2075 X0.2500 Y0.3750
N2080 X0.7500
N2085 X0.7500 Y1.6250
N2090 X0.2500
N2095 X0.2500 Y1.0000
N2100 X0.2500 Z-0.0250
N2105 G00 Z1.0008
N2110 X-0.1250 Y0.0000
N2115 Z0.5138
N2120 G01 X-0.1250 Z-0.1250
N2125 X-0.1250 Y2.0000 F220
N2130 I0.0000 J2.0000 G02 X0.0000 Y2.1250
N2135 G01 X1.0000
N2140 I1.0000 J2.0000 G02 X1.1250 Y2.0000
N2145 G01 X1.1250 Y0.0000
```

Operation #3

Tool change - 1/4" end mill
Operation #4


```
N2150 I1.0000 J0.0000 G02 X1.0000 Y-0.1250
N2155 G01 X0.0000
N2160 I0.0000 J0.0000 G02 X-0.1250 Y0.0000
N2165 G01 X-0.1250 Z-0.0250 F180
N2170 G00 Z1.0008
N2175 X1.2500 Y1.0000
N2180 Z-0.0250
N2185 G01 X1.2500 Z-0.3750
N2190 X1.2500 Y1.6350
N2195 X1.2500 Y0.3650
N2200 X1.2500 Y1.0000
N2205 X1.3750
N2210 X1.3750 Y1.7936
N2215 I1.2498 J2.0100 G02 X1.2498 Y1.7600
N2220 I1.2498 J2.0100 X1.1250 Y1.7934
N2225 G01 X1.1250 Y0.2066
N2230 I1.2498 J-0.0100 G02 X1.2498 Y0.2400
N2235 I1.2498 J-0.0100 X1.3750 Y0.2064
N2240 G01 X1.3750 Y1.0000
N2245 X1.3750 Y2.1250
N2250 X1.0000
N2255 F220
N2260 I1.0000 J2.0000 G02 X1.1250 Y2.0000
N2265 G01 X1.1250 Y1.7934
N2270 X1.1250 Z-0.2750 F180
N2275 G00 Z1.0008
N2280 Y0.2066
N2285 Z-0.0250
N2290 G01 X1.1250 Z-0.3750
N2295 X1.1250 Y0.0000 F220
N2300 I1.0000 J0.0000 G02 X1.0000 Y-0.1250
N2305 G01 X1.5000 F180
N2310 F220
N2315 I1.5000 J0.0000 G02 X1.3750 Y0.0000
N2320 G01 X1.3750 Y0.2064
N2325 X1.3750 Z-0.2750 F180
N2330 G00 Z1.0008
N2335 Y1.7936
N2340 Z-0.0250
N2345 G01 X1.3750 Z-0.3750
N2350 X1.3750 Y2.0000 F220
N2355 I1.5000 J2.0000 G02 X1.5000 Y2.1250
N2360 G01 X1.5000 Z-0.2750 F180
N2365 G00 Z1.0008
N2370 Z1.0000
N2375 X-5.0000 Y0.0000
N2380 M6
N2385 T3
N2390 S1800 M3
N2395 G00 X0.5000 Y1.3750 Z1.0008
N2400 G83 P01-1.0758 P02-0.5750 P03-0.1150 P040 P0586
N2405 G79
N2410 G00 X0.5000 Y0.6250 Z1.0008
N2415 G83 P01-1.0758 P02-0.5750 P03-0.1150 P040 P0586
N2420 G79
N2425 G00 Z1.0000
N2430 X-5.0000 Y0.0000
N2435 T0
N2440 M30
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Tool change - 1/4 in drill
Operation #5